Two stories about data and sport

Luck and the Law

Sports During a Pandemic

Peko Hosoi

Sports Lab
Massachusetts Institute of Technology

IDSS
MIT INSTITUTE FOR DATA, SYSTEMS, AND SOCIETY

Fantasy sports primer …

Fantasy sports primer …

How to play fantasy sports

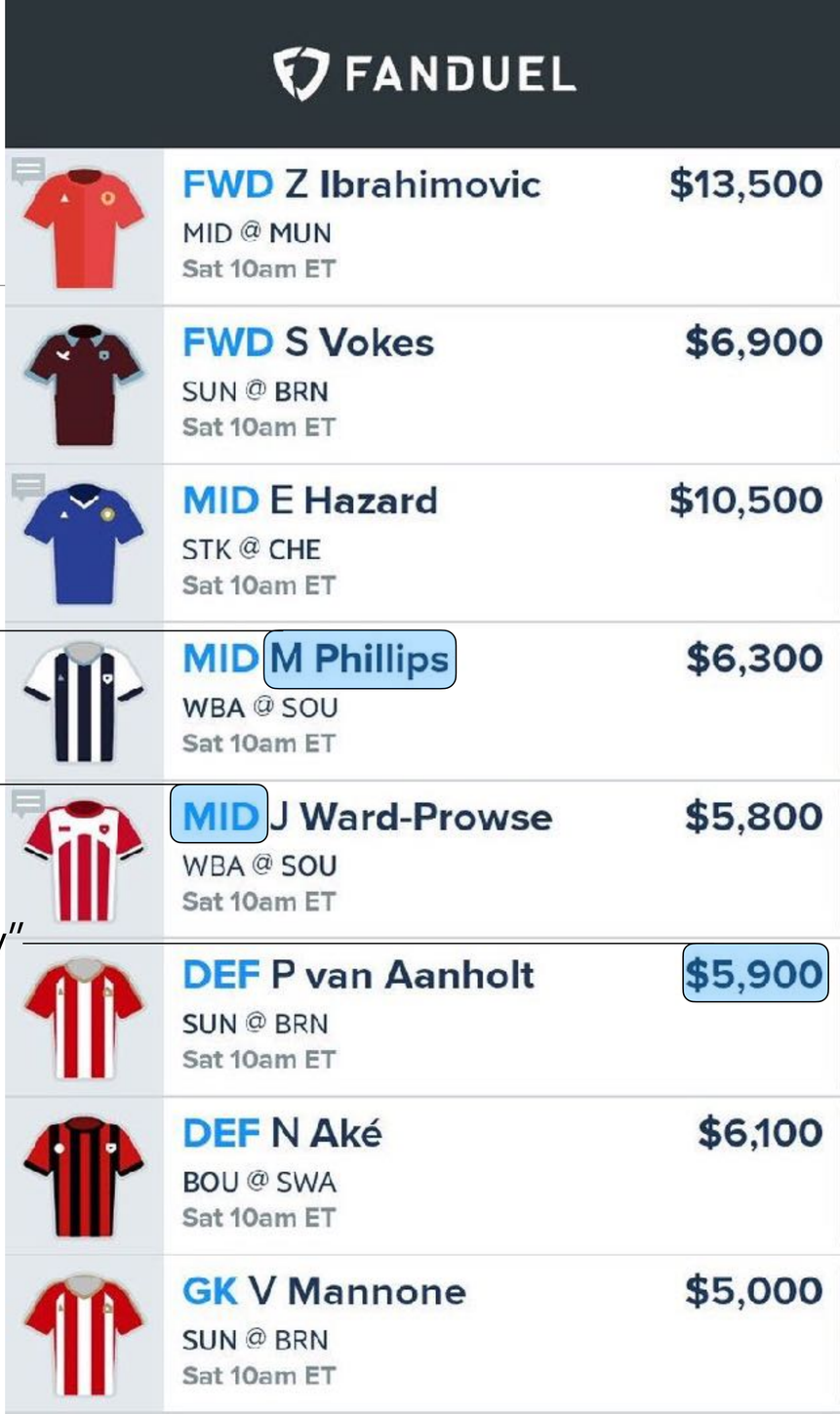
Step 1: Form a league

How to play fantasy sports

Step 1: Form a league

Step 2: Draft your team

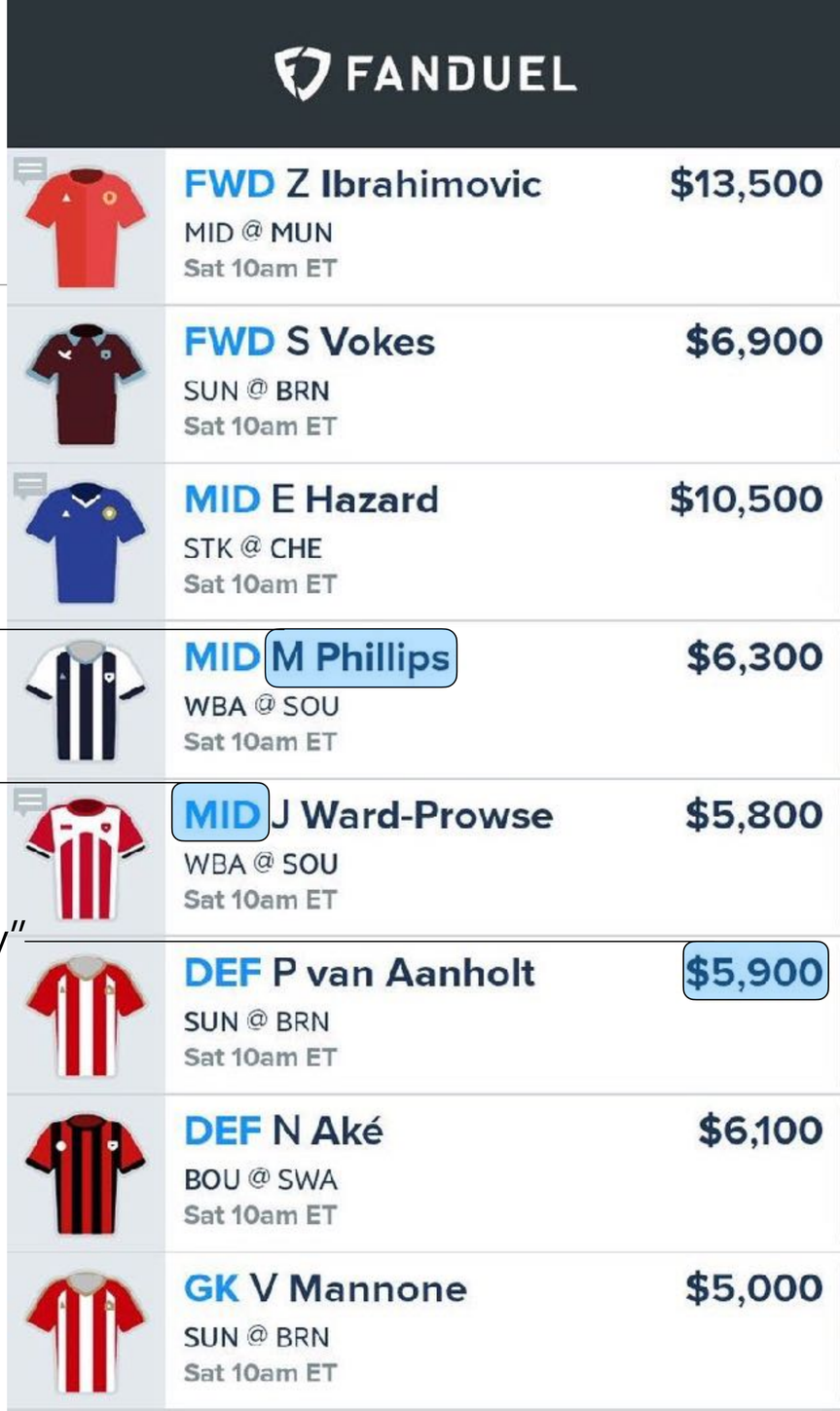
FWD	FWD	FWD
MID	MID	MID
DEF	DEF	GK



How to play fantasy sports

Step 1: Form a league

Step 2: Draft your team

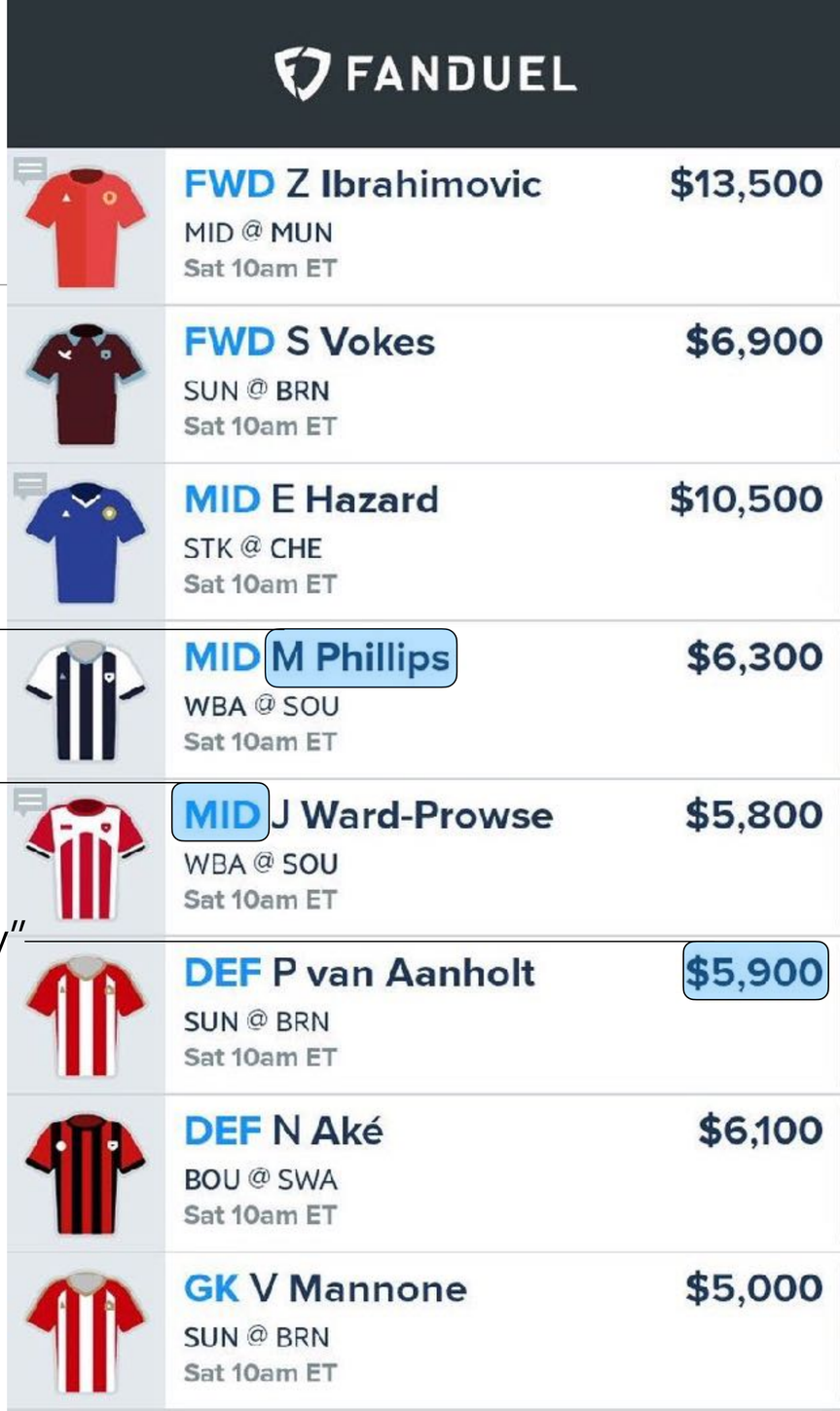


How to play fantasy sports

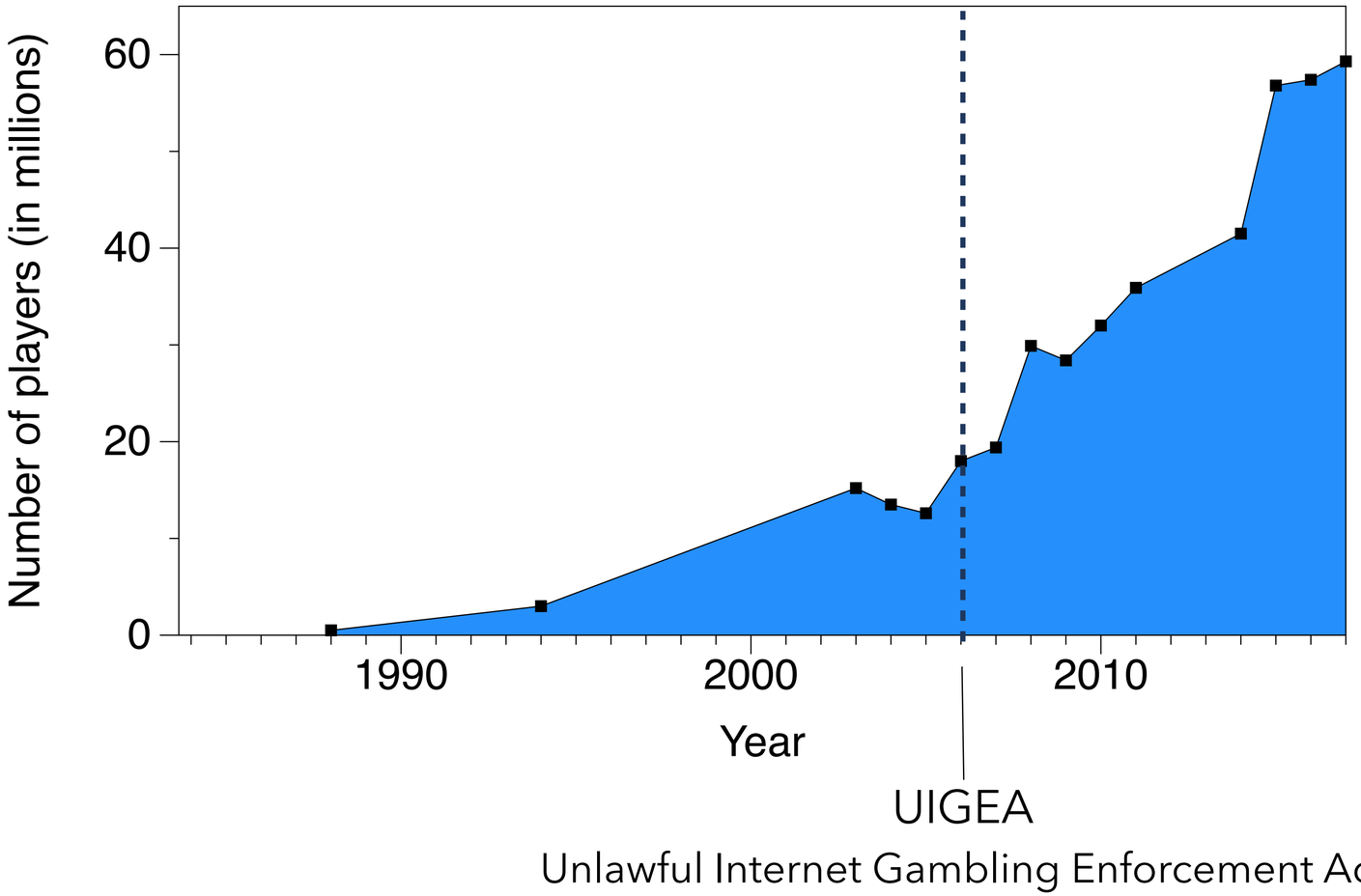
Step 1: Form a league

Step 2: Draft your team

Step 3: Watch football! Score points based on athlete performance



Recent history of fantasy sports



Daily Fantasy Sports

DRAFT KINGS
THE GAME INSIDE THE GAME.

FANDUEL

Legal debate: Is is gambling?

(1) Bet or wager.—The term "bet or wager"—

(E) does ***not*** include—

(ix) participation in any fantasy or simulation sports game ... in which ... no fantasy or simulation sports team is based on the current membership of an actual team ... and that meets the following conditions:

(II) All winning outcomes reflect **the relative knowledge and skill of the participants and are determined predominantly by accumulated statistical results** of the performance of individuals (athletes in the case of sports events) in multiple real-world sporting or other events.

The data

Types of contest: 50/50 and head-to-head

	MLB	NBA	NFL	NHL
#plrs (H2H)	89,338	107, 796	190,562	20,802
#plrs (50/50)	130,515	158,532	312,263	30,607
Max games/plr	686	383	155	271
Max entries/plr	60,200	64,287	49,657	21,209

29,299,240 entries

Each entry contains:

- Player ID
- Game ID
- # of entries
- win fraction
- average points scored
- max points scored
- …

Detecting games of chance

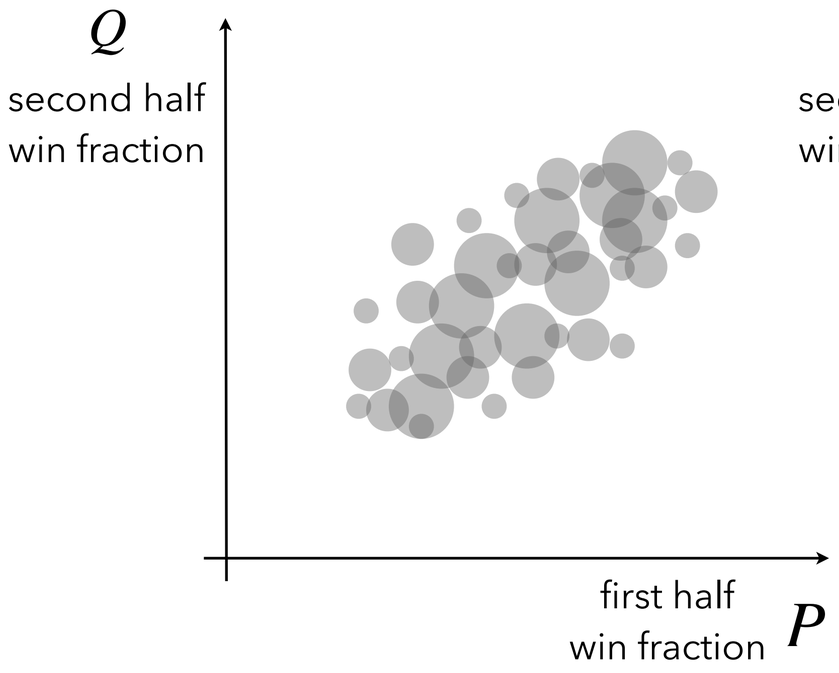
Is Texas Hold 'Em a Game of Chance? A Legal and Economic Analysis

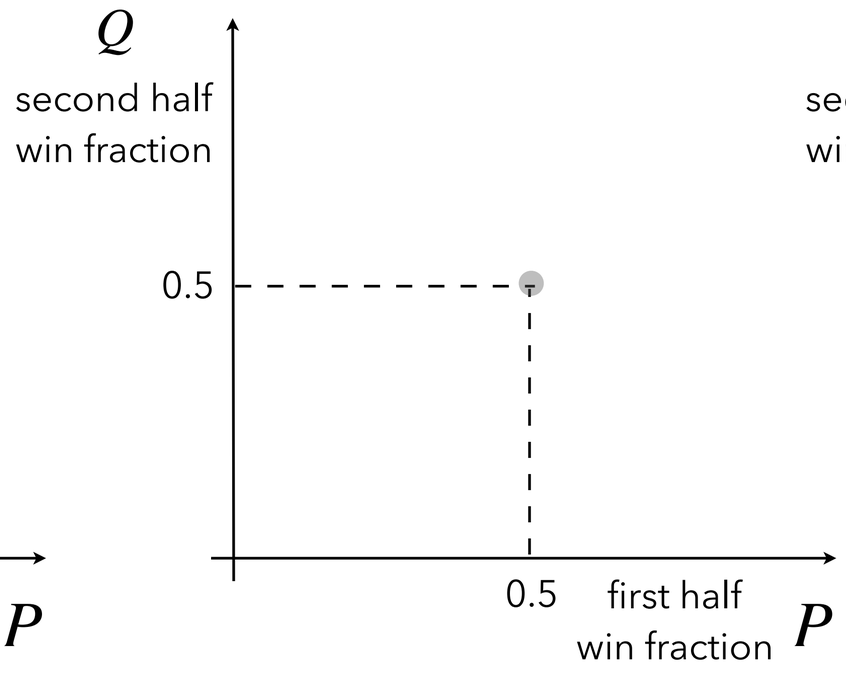
STEVEN D. LEVITT, THOMAS J. MILES, AND ANDREW M. ROSENFIELD*

THE GEORGETOWN LAW JOURNAL

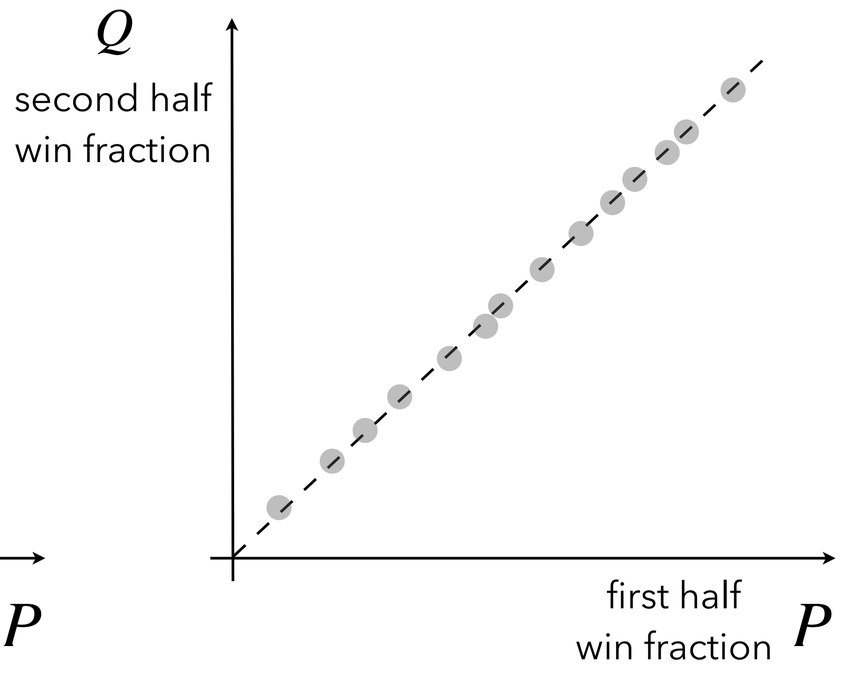
1. Do players have different expected payoffs when playing the game?
2. Do observable characteristics of the player correlate with the payoffs they receive?
3. Do actions that players take in the game have statistically significant impacts on the payoffs that are achieved?
4. Are payoffs serially correlated (implying a persistence of skill)?

Limits of luck- and skill-dominated games



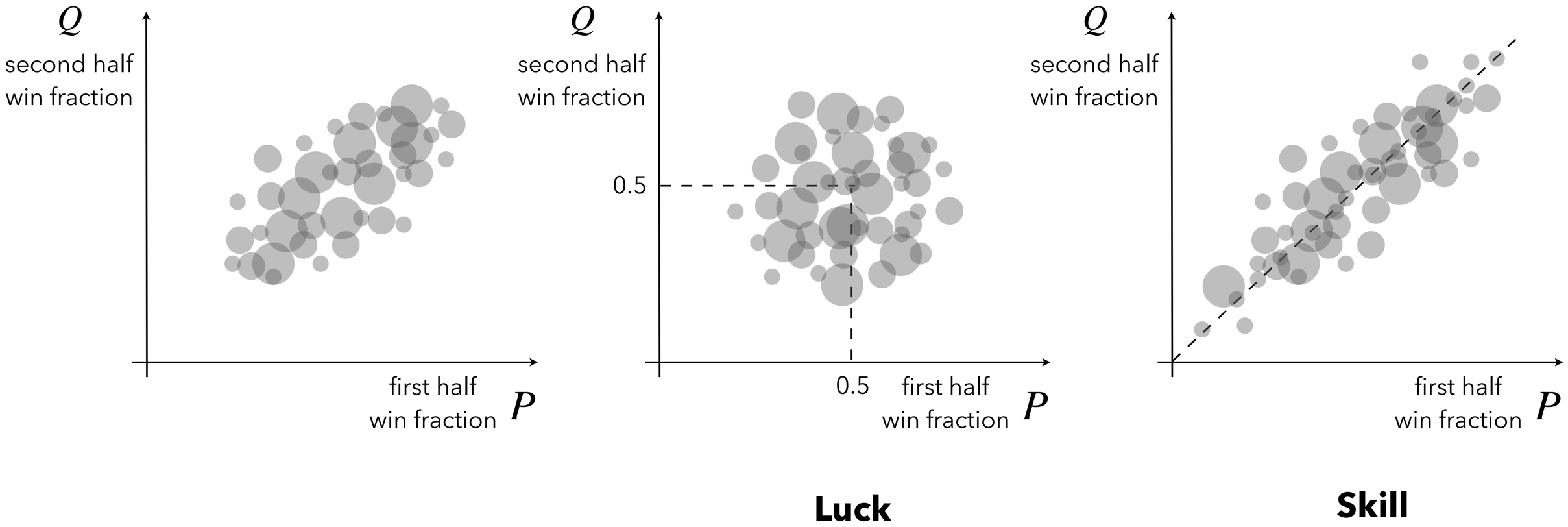


Luck



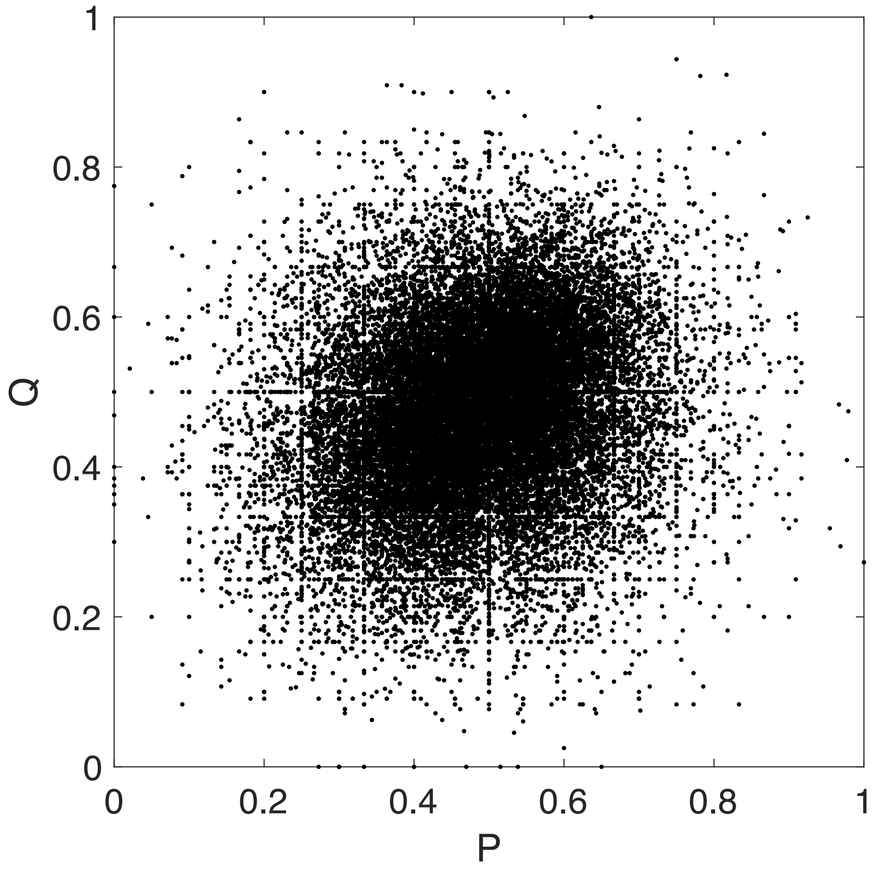
Skill

Limits of luck- and skill-dominated games



Luck

Skill


1
0.8
0.6
0.4
0.2
0
Q
0
0.2
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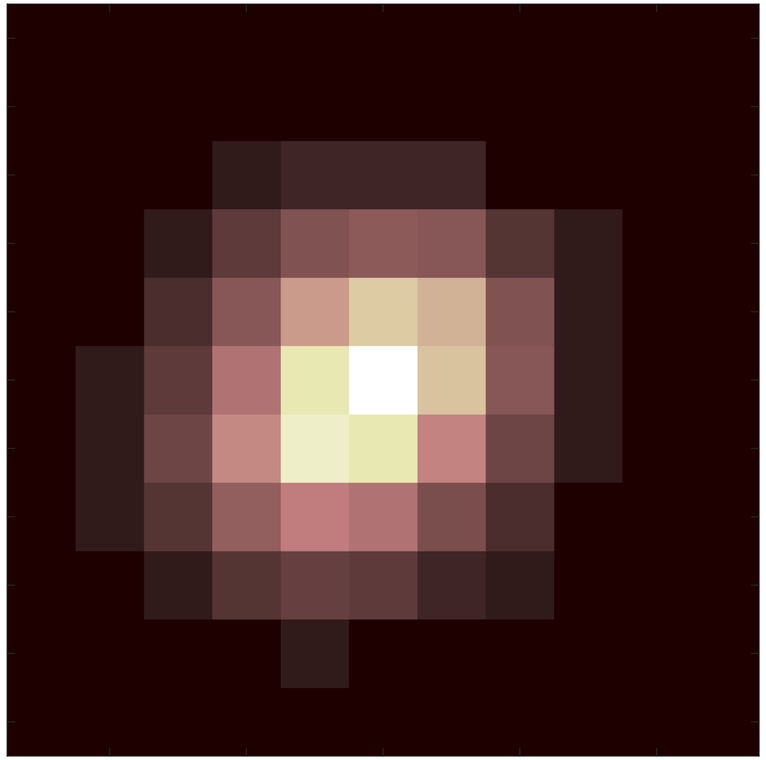
0.6
0.8
1
P



N = 4

MLB

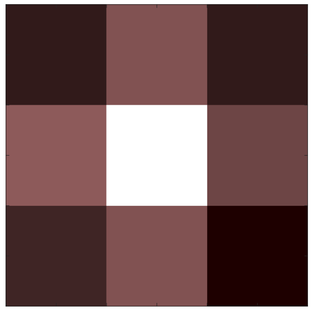
NBA

NFL

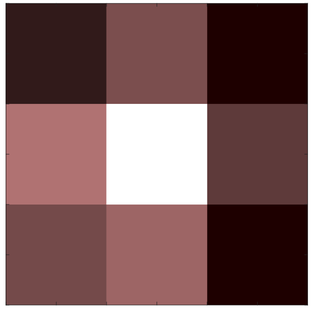
NHL

N = 4

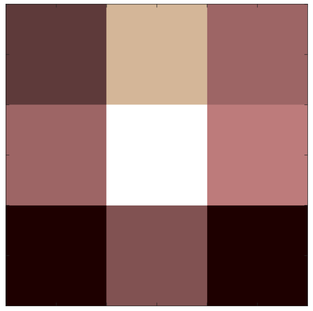
MLB



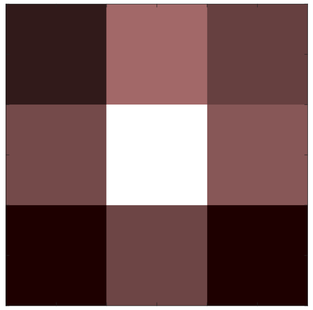
NBA



NFL



NHL

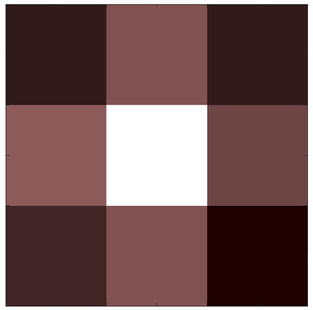


"Even tiny differences in skill manifest themselves in near certain victory if the time horizon is long enough."

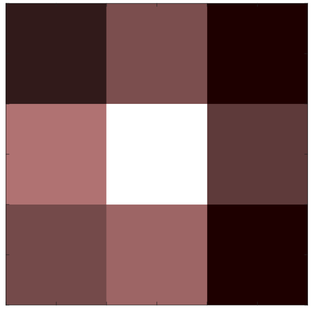
– Levitt, Miles, Rosenfield (2012)

N = 4 N = 16 N = 64 N = N_{Real}

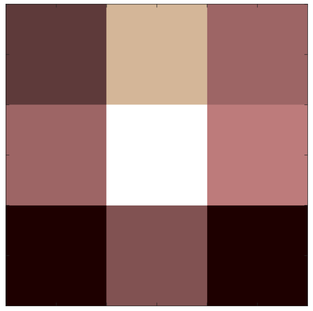
MLB



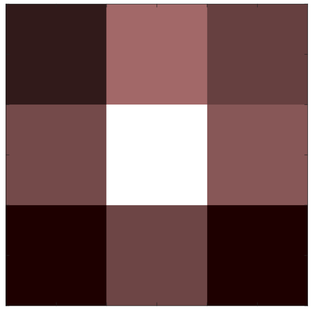
NBA



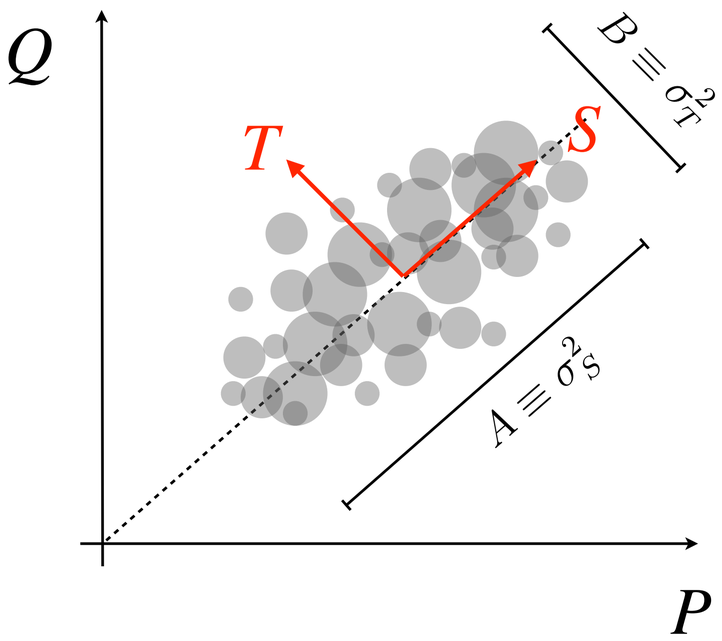
NFL

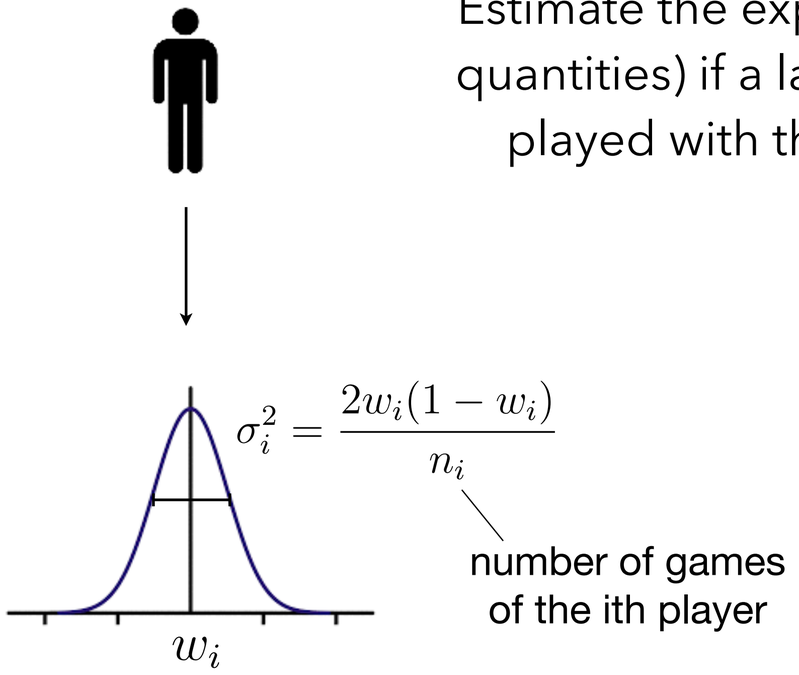


NHL



Quantifying the role of skill





win fraction of the ith player

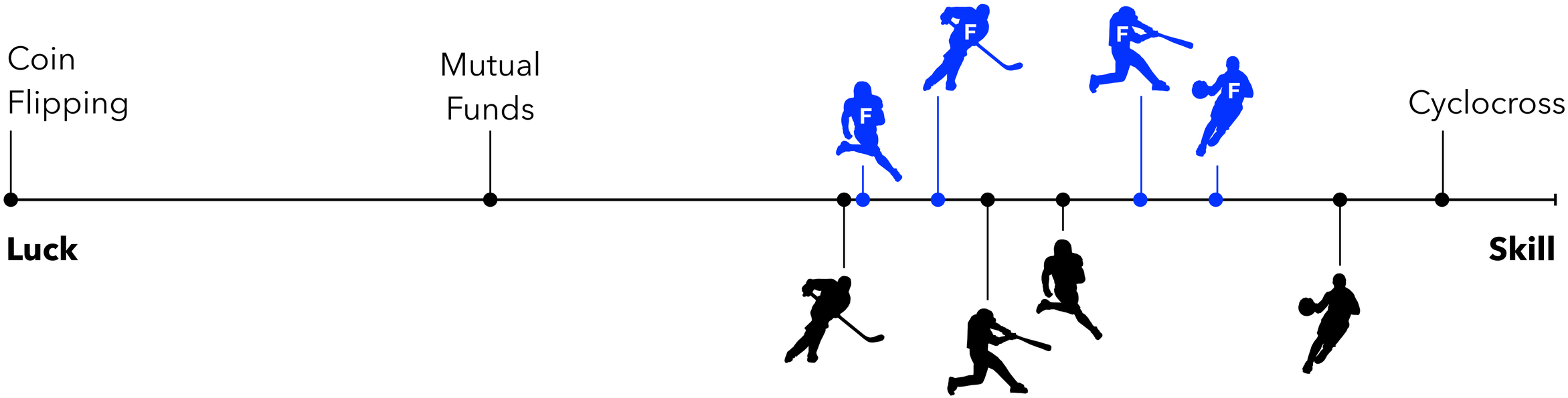
number of games of the ith player

Estimate the expected value of R* (and other quantities) if a large number of seasons were played with the same player population.

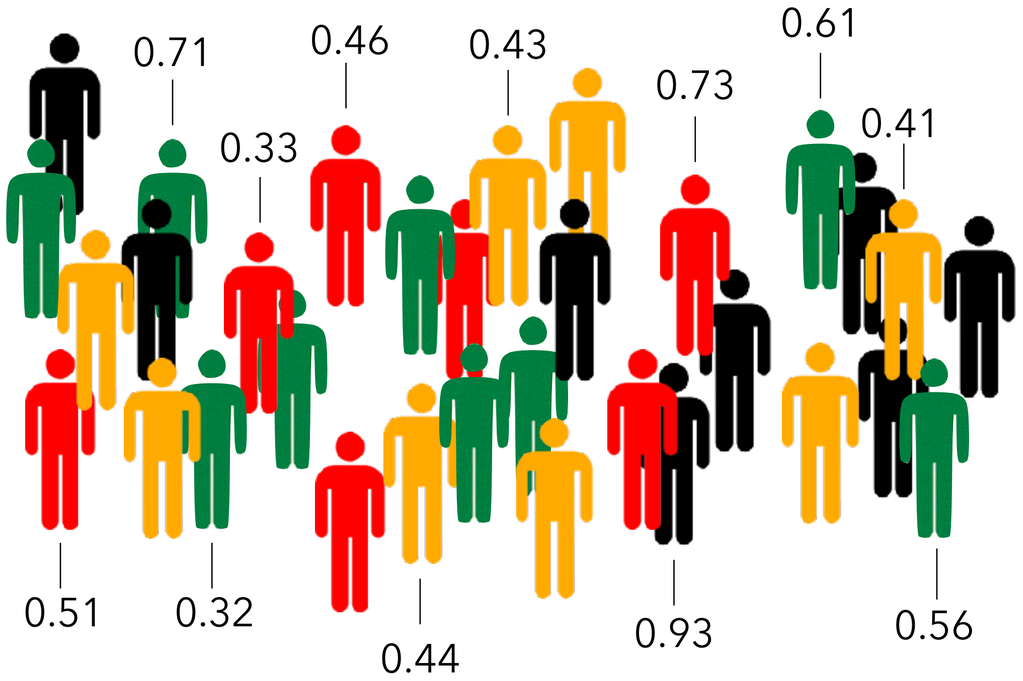
1. Monte Carlo
2. Analytical estimate

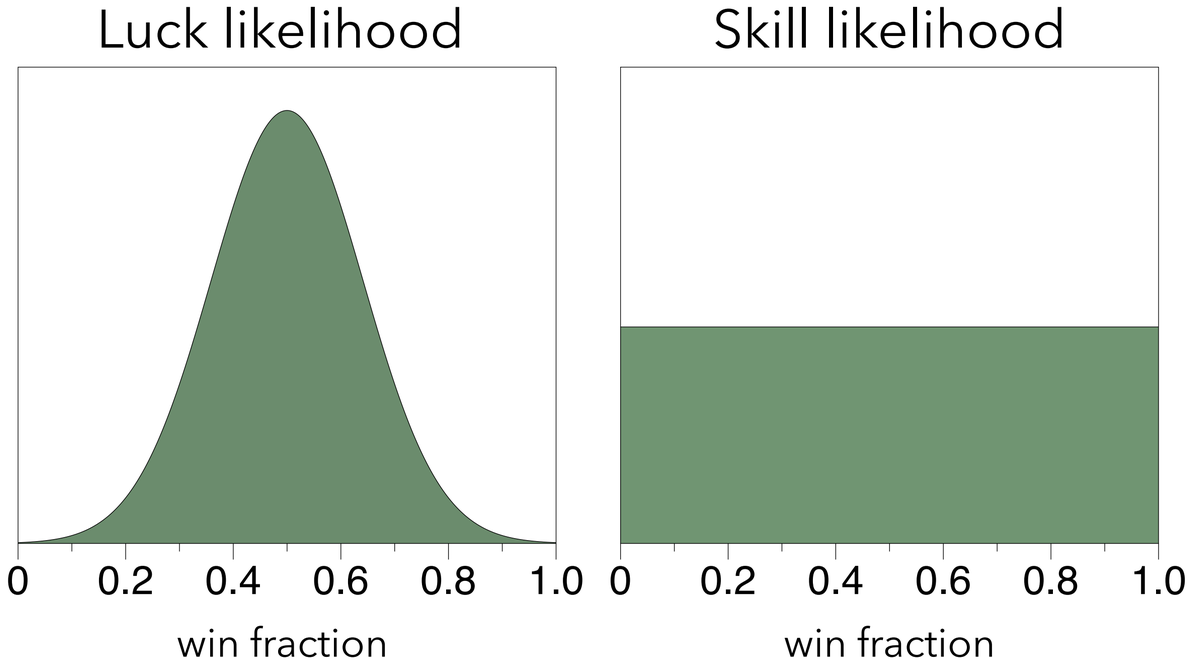
$$E[\hat{R}^*] = 1 - \left[1 + \frac{1}{m}\sum_{i=1}^{m} \frac{(2\hat{w}_i - 1)^2 n_i}{2\hat{w}_i(1-\hat{w}_i)}\right]^{-1}$$

Skill-Luck Spectrum



A Comment on Bayesian Inference





$$P(\text{ Skill }|w_i) = \frac{P(w_i|\text{ Skill })P(\text{ Skill })}{P(w_i)}$$

Probability that this is a game of skill

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Luck and the Law: Quantifying Chance in Fantasy Sports and Other Contests*

Daniel Getty†
Hao Li‡
Masayuki Yano§
Charles Gao¶
A. E. Hosoi‖

SUPREME COURT OF THE STATE OF NEW YORK
COUNTY OF NEW YORK

FANDUEL INC.,

Plaintiff,

-against-

ERIC SCHNEIDERMAN, in his official capacity as Attorney General of the State of New York, and the STATE OF NEW YORK,

Defendants.

Index No. 161691/2015
Motion Sequence No. 1
IAS Part 13 (Justice Mendez)

AFFIDAVIT OF PROFESSOR ANETTE (PEKO) HOSOI

Note: FanDuel is also filing this affidavit in *People by Schneiderman v. FanDuel, Inc.*, Index No. 453056/2015.

Is it ok to have sports fans in stadiums during a pandemic?

Of the 32 teams in the NFL, 19 have opened their stadiums to fans at some point this season.

DALLAS COWBOYS EST. 1960

"Safe Stadium Policy"

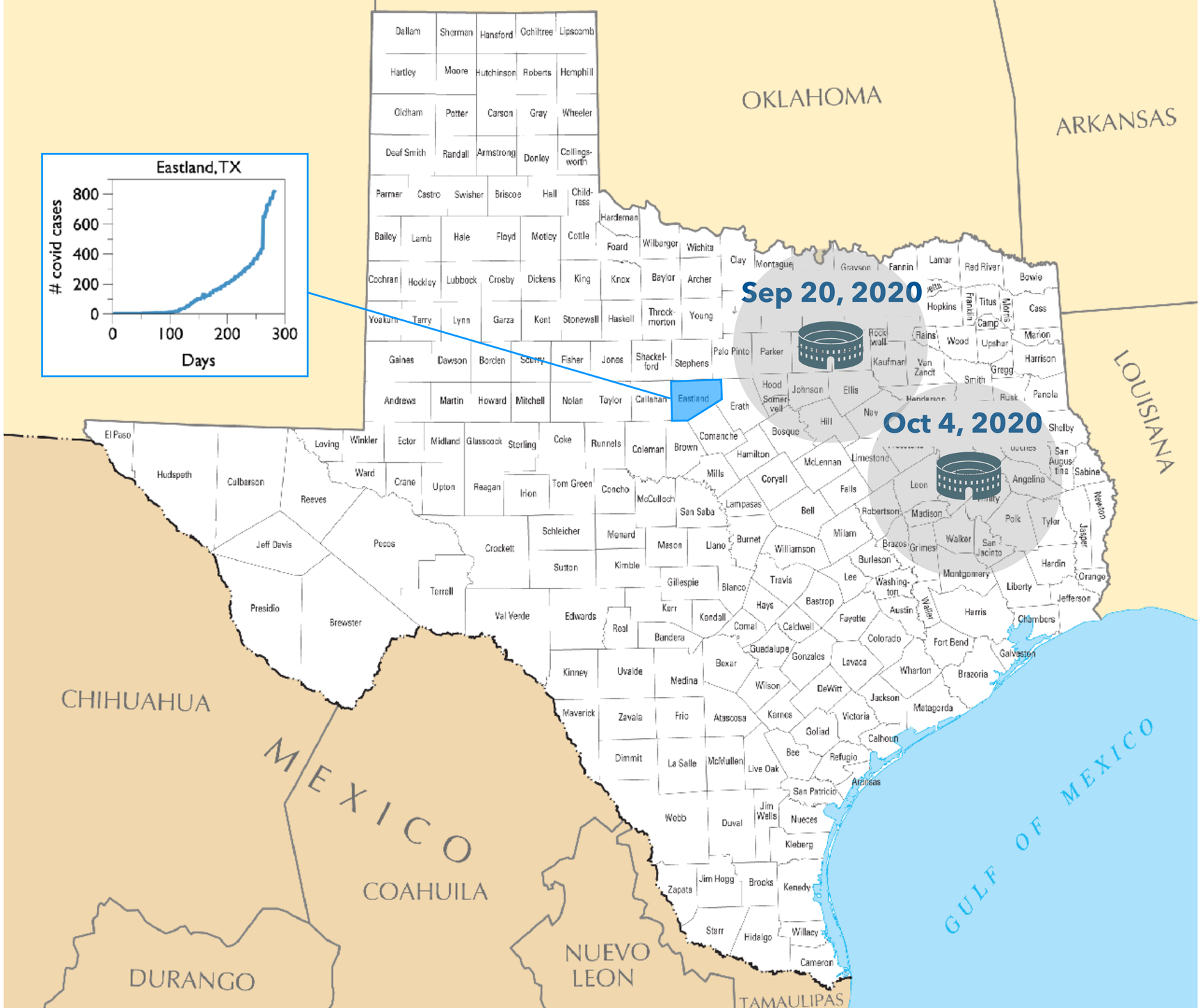
- Limited capacity (most operating at ~15%)
- Masks required when not eating or drinking
- Seating in family "pods"
- Cashless purchasing only
- Socially distanced entry points

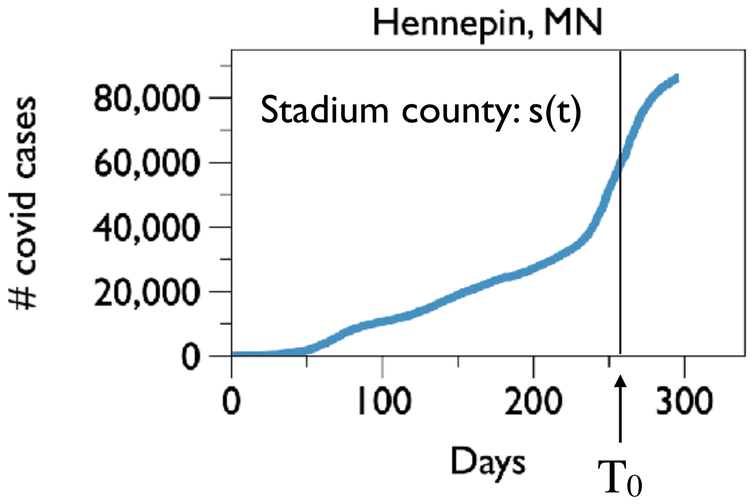
What info do we have?

- Location of stadium
- Date that each stadium opened
- # of reported Covid cases daily at the county level (NYTimes Covid GitHub)

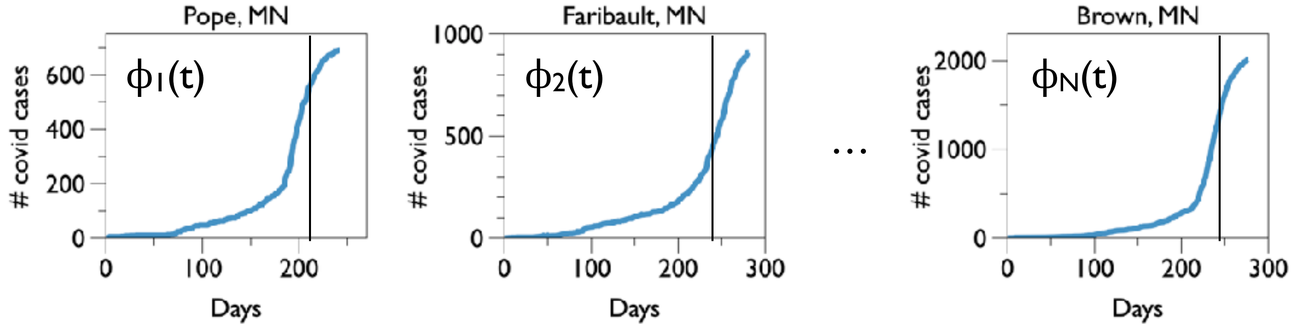
Synthetic Control

- Use the rest of the counties in Texas to build a synthetic Dallas and a synthetic Houston
- Compare case counts of synthetic counties with real Dallas and Houston to estimate impact of opening stadium





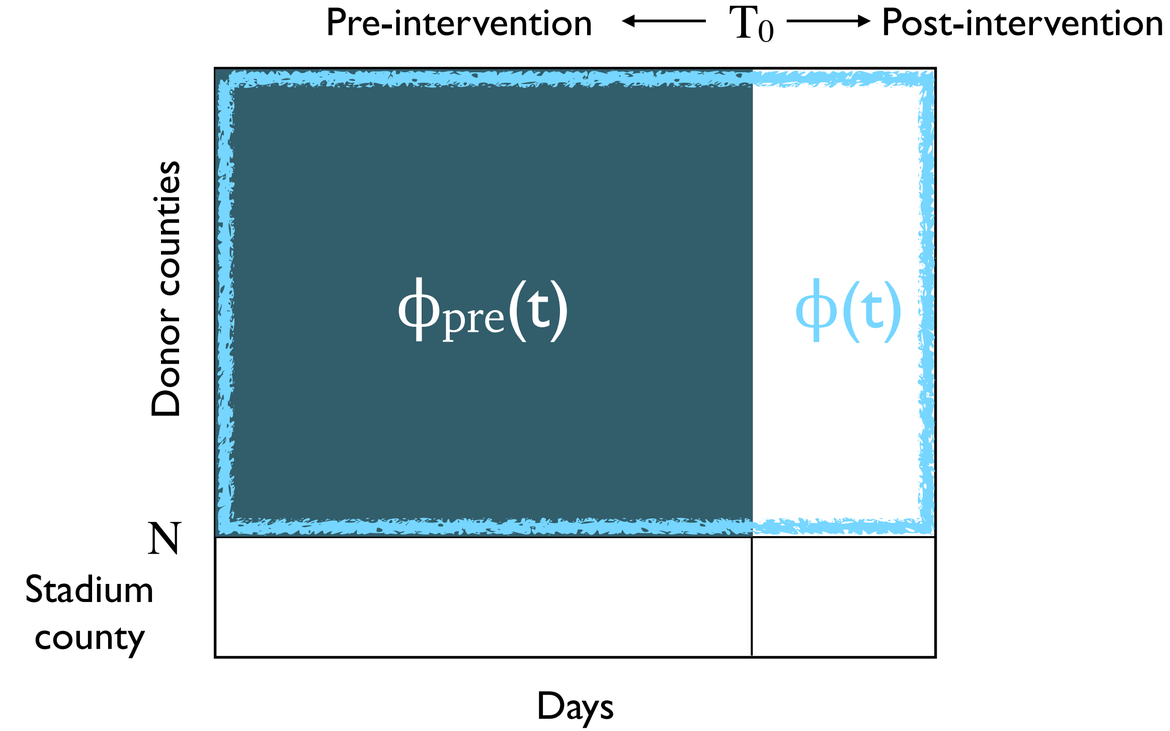
Donor counties: $\phi_i(t)$

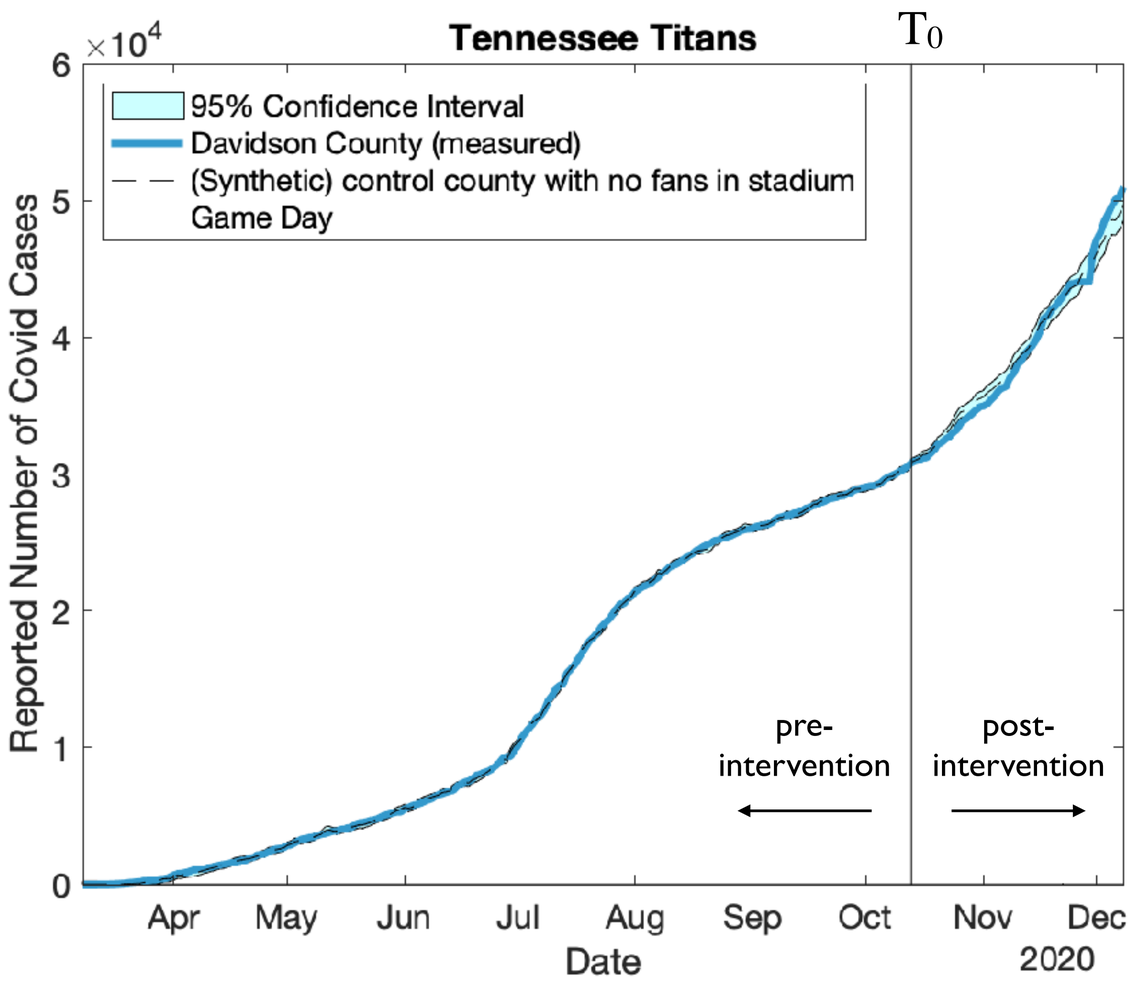


$$s(t) \approx \sum_{i=1}^{N} \alpha_i \phi_i(t) = s_{\text{syn}}(t)$$

Find α_i s.t.:

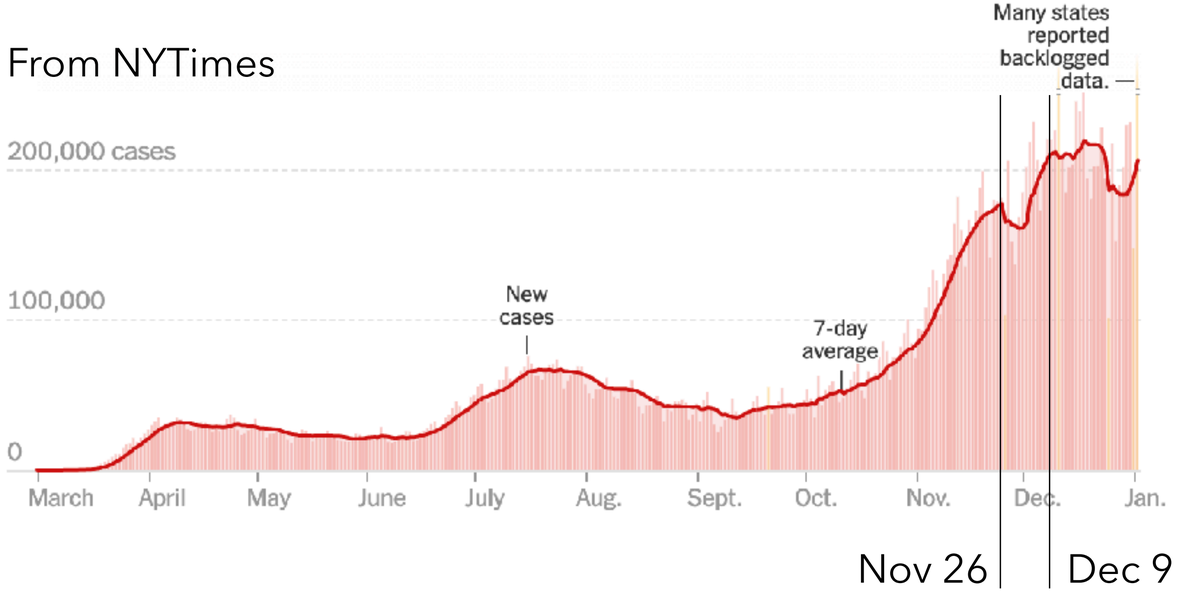
$$\min \int_0^{T_0} \left(\sum_{i=1}^{N} \alpha_i \phi_{\text{pre},i}(t) - s_{\text{pre}}(t) \right)^2 dt$$

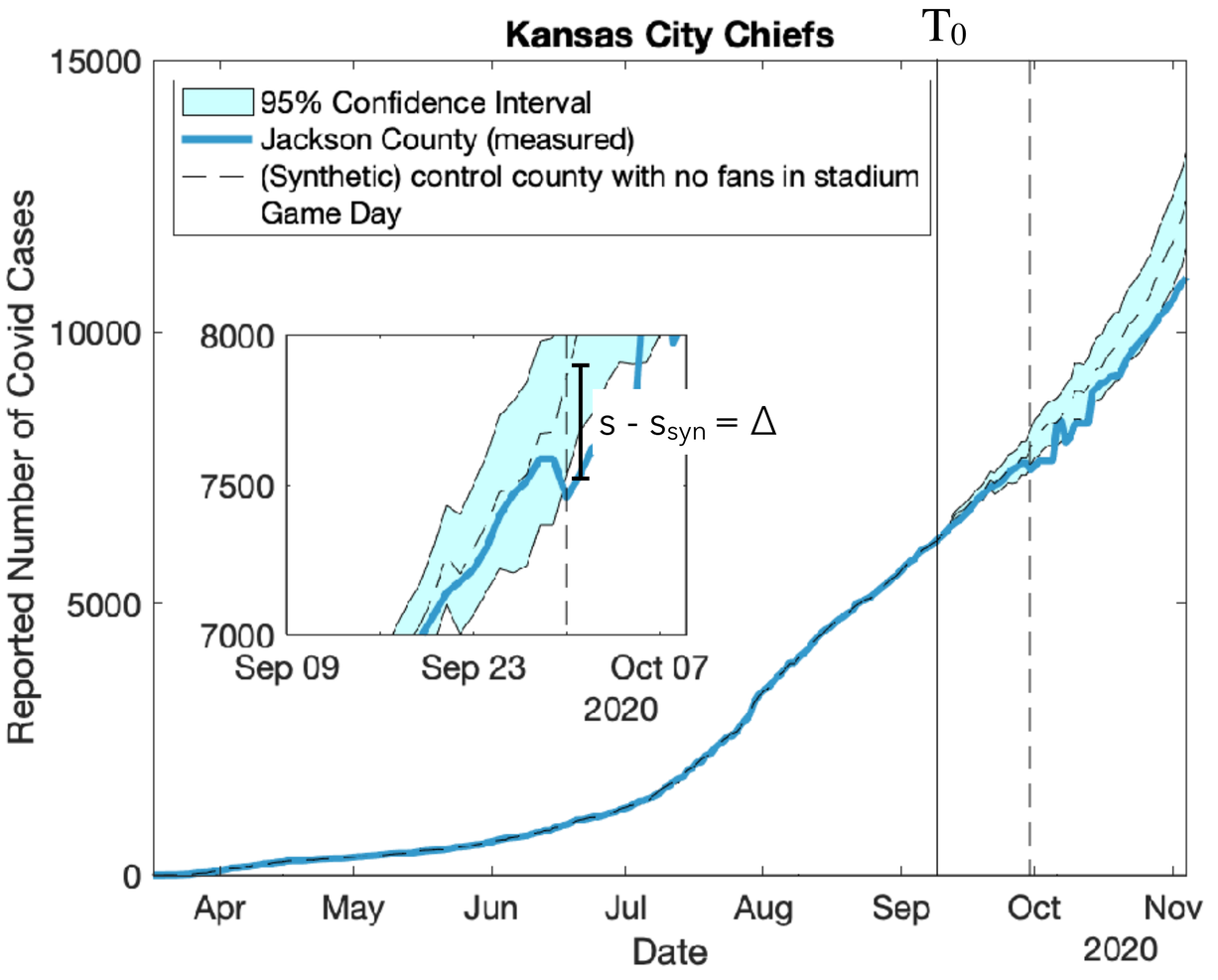


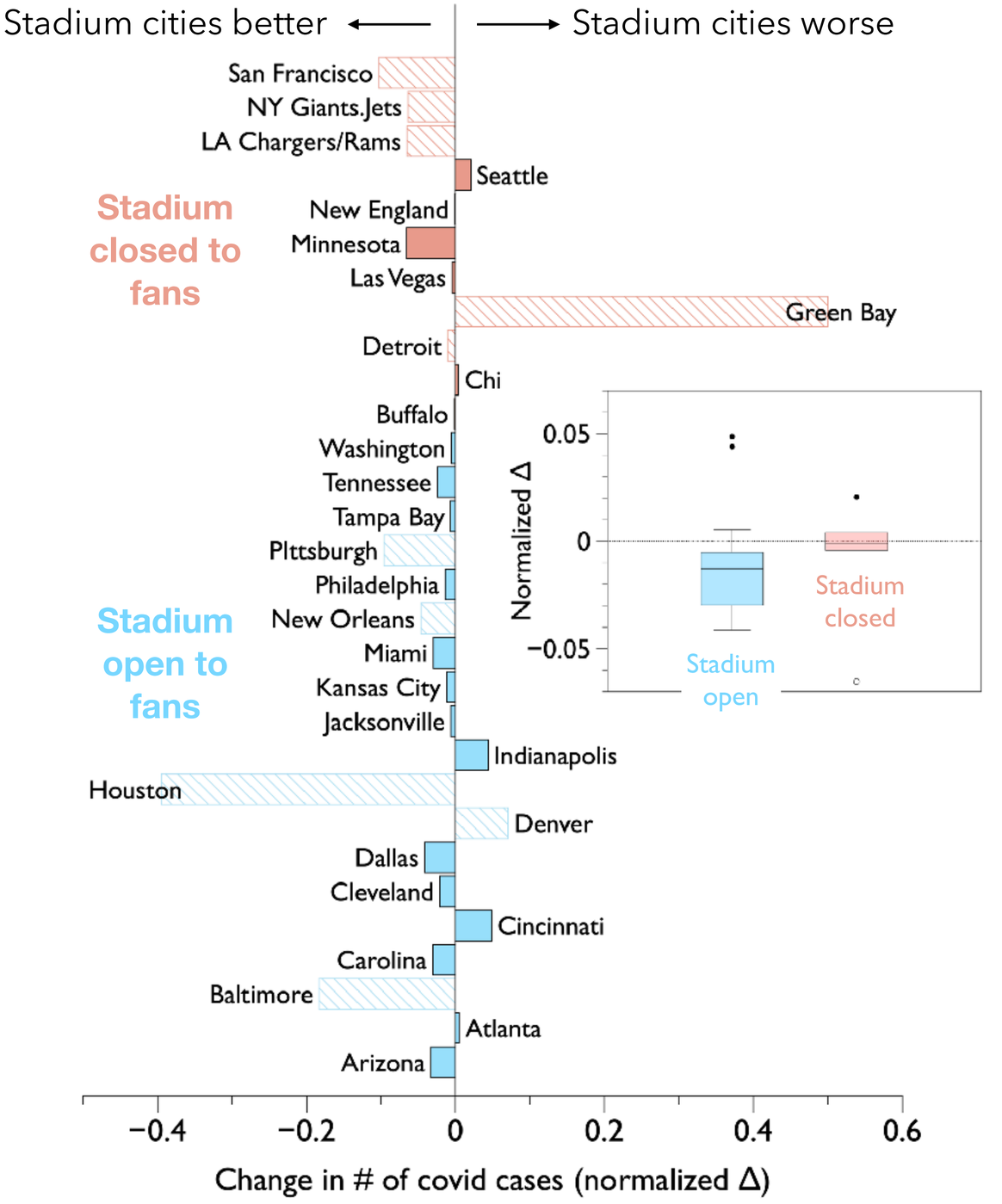


Expect to see impact of opening stadium 2-3 weeks after the event

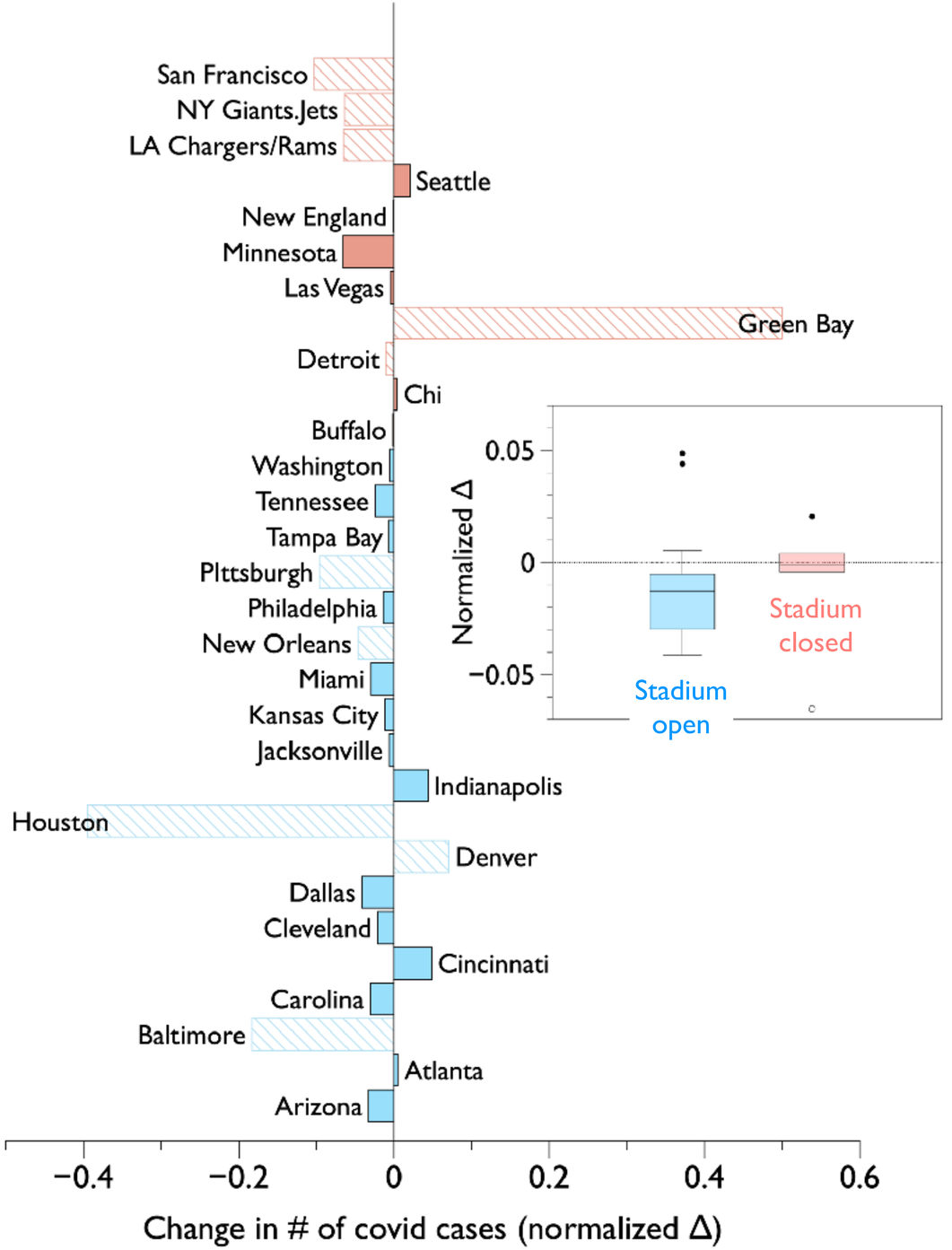
From NYTimes



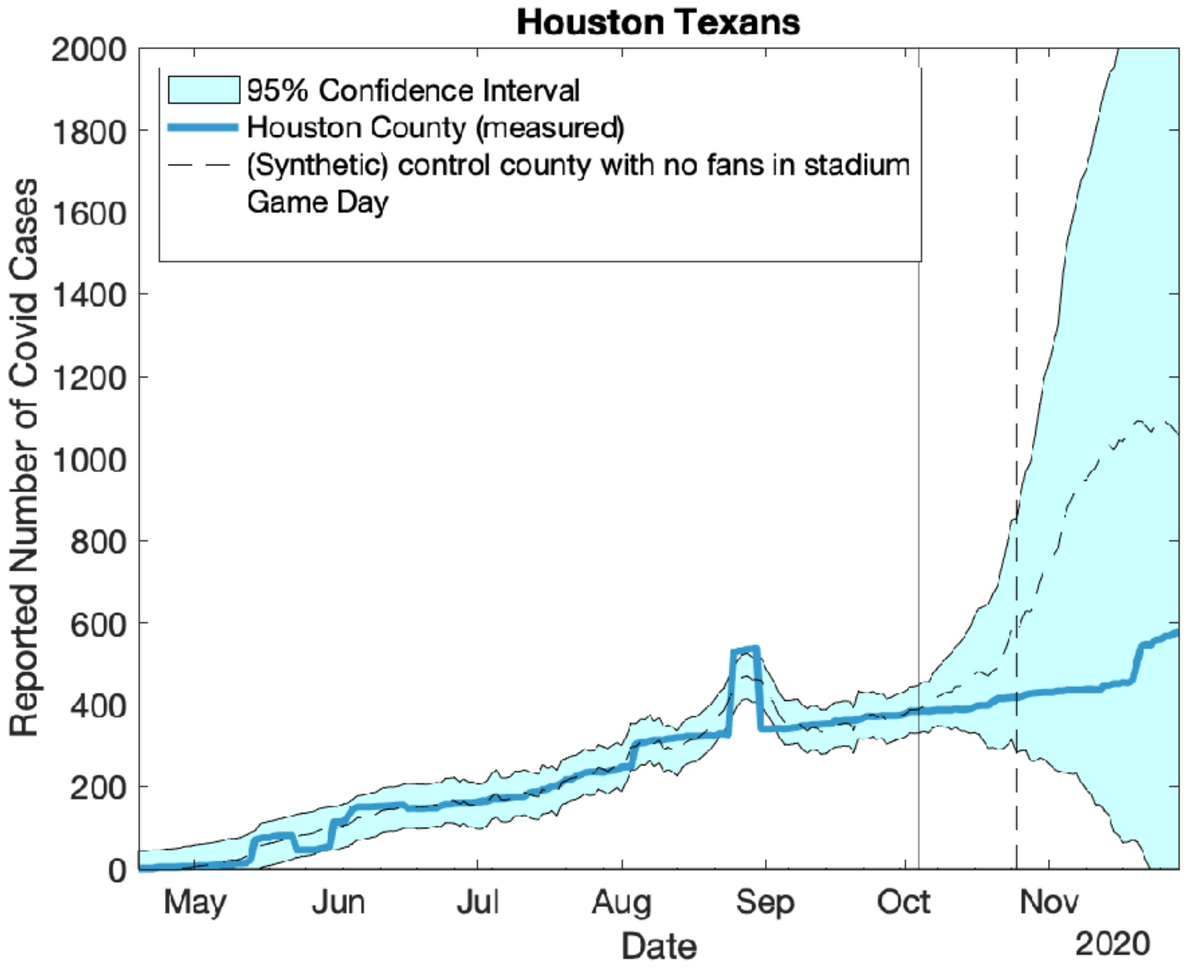

Kansas City Chiefs
T_0
95% Confidence Interval
Jackson County (measured)
(Synthetic) control county with no fans in stadium
Game Day
$s - s_{syn} = \Delta$
Reported Number of Covid Cases
15000
10000
5000
0
8000
7500
7000
Sep 09
Sep 23
Oct 07
2020
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
2020
Date

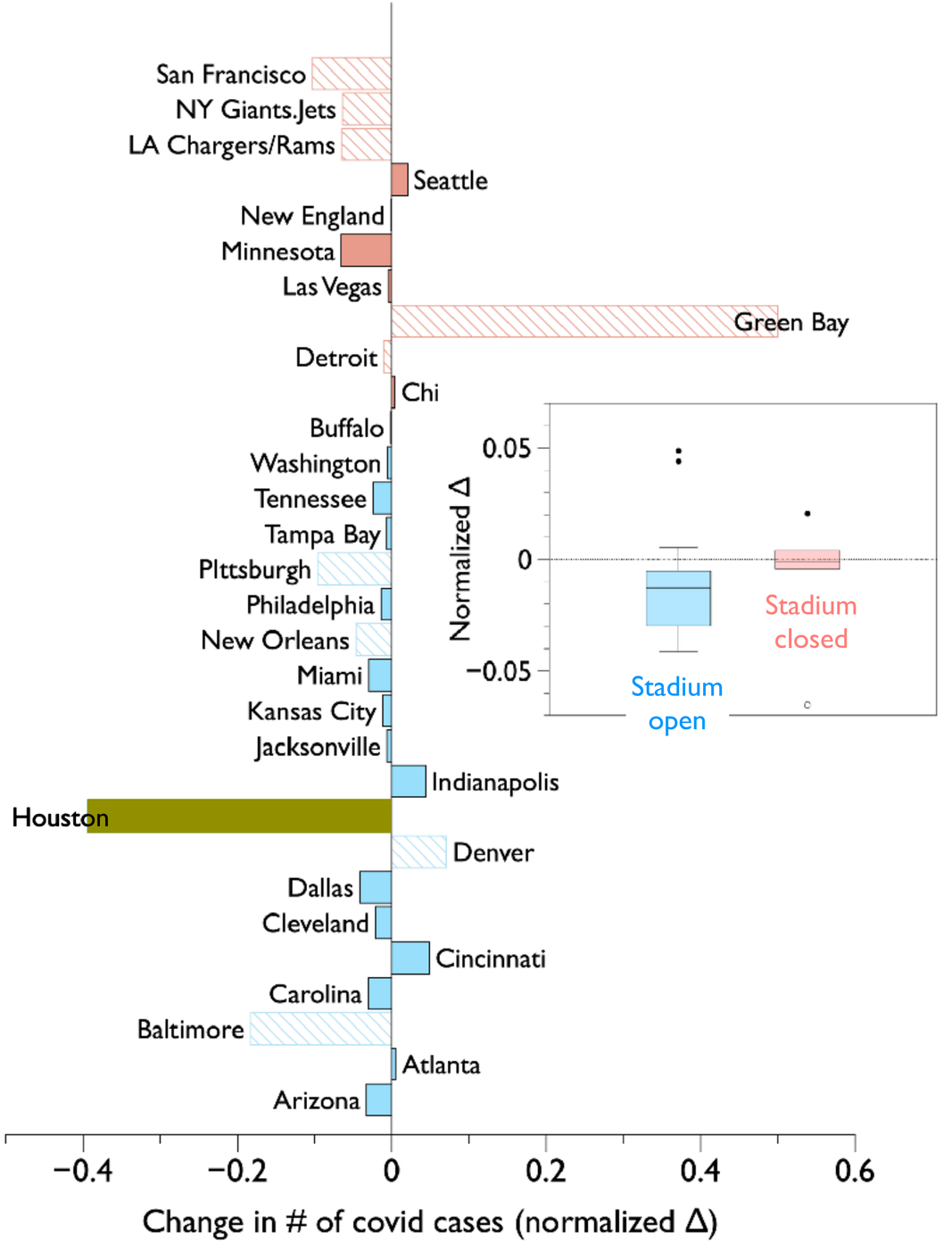

Stadium cities better
Stadium cities worse
Stadium closed to fans
Stadium open to fans
San Francisco
NY Giants.Jets
LA Chargers/Rams
Seattle
New England
Minnesota
Las Vegas
Green Bay
Detroit
Chi
Buffalo
Washington
Tennessee
Tampa Bay
Pittsburgh
Philadelphia
New Orleans
Miami
Kansas City
Jacksonville
Indianapolis
Houston
Denver
Dallas
Cleveland
Cincinnati
Carolina
Baltimore
Atlanta
Arizona
−0.4
−0.2
0
0.2
0.4
0.6
Change in # of covid cases (normalized Δ)
Normalized Δ
0.05
0
−0.05
Stadium open
Stadium closed

Big Picture: NFL's strategy for opening stadiums to fans has been effective (i.e. there does not appear to be any signifi cant impact on the spread of covid)



What can go wrong?





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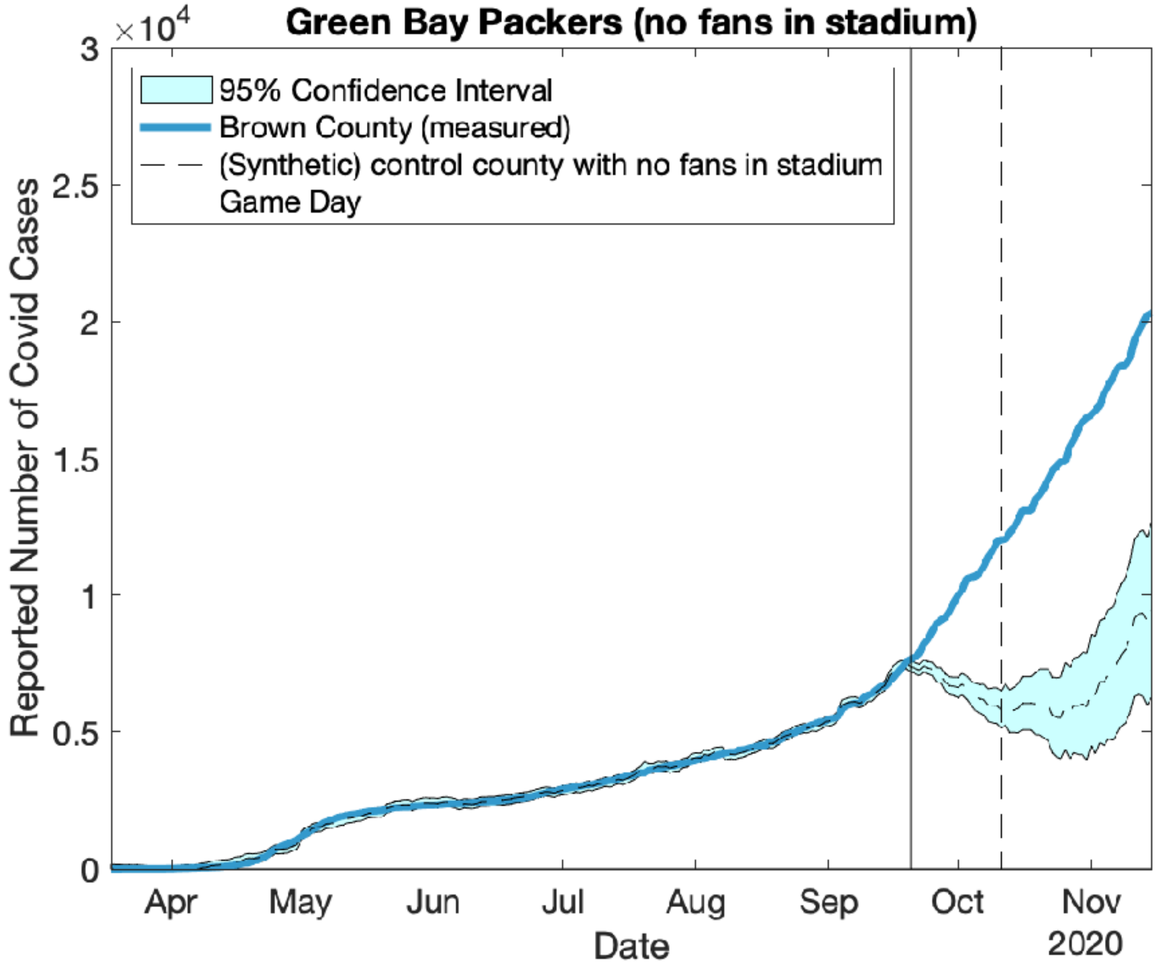
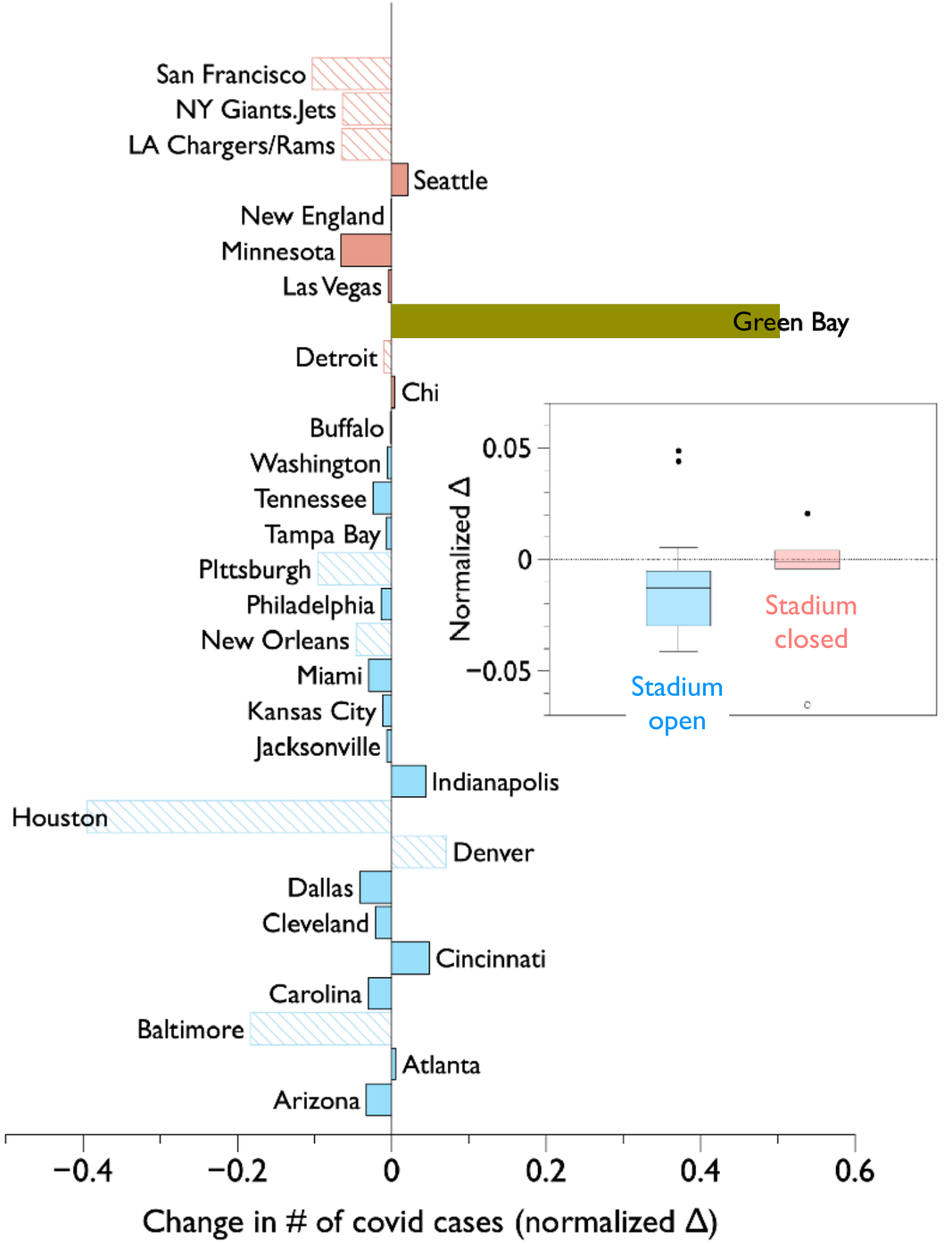




Health

How the Sturgis Motorcycle Rally may have spread coronavirus across the Upper Midwest

The Washington Post
Democracy Dies in Darkness

Within weeks of the gathering that drew nearly half a million bikers, the Dakotas, along with Wyoming, Minnesota and Montana, were leading the nation in new coronavirus infections per capita

The New York Times

A Motorcycle Rally in a Pandemic? 'We Kind of Knew What Was Going to Happen'

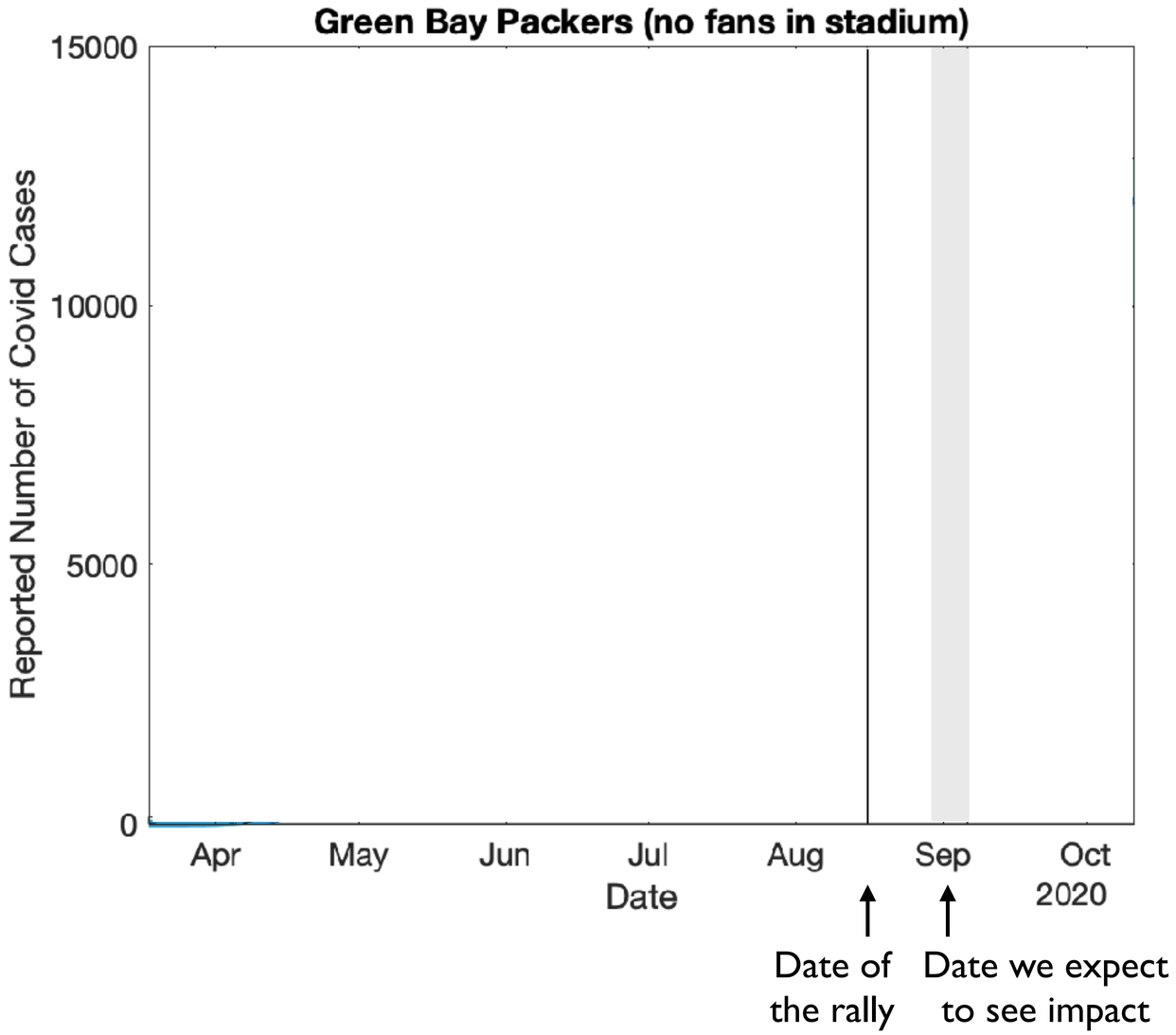
Infectious-disease experts warned about the risk of cramming revelers into the Black Hills of South Dakota. But it was the annual Sturgis rally, and bikers were coming no matter what.

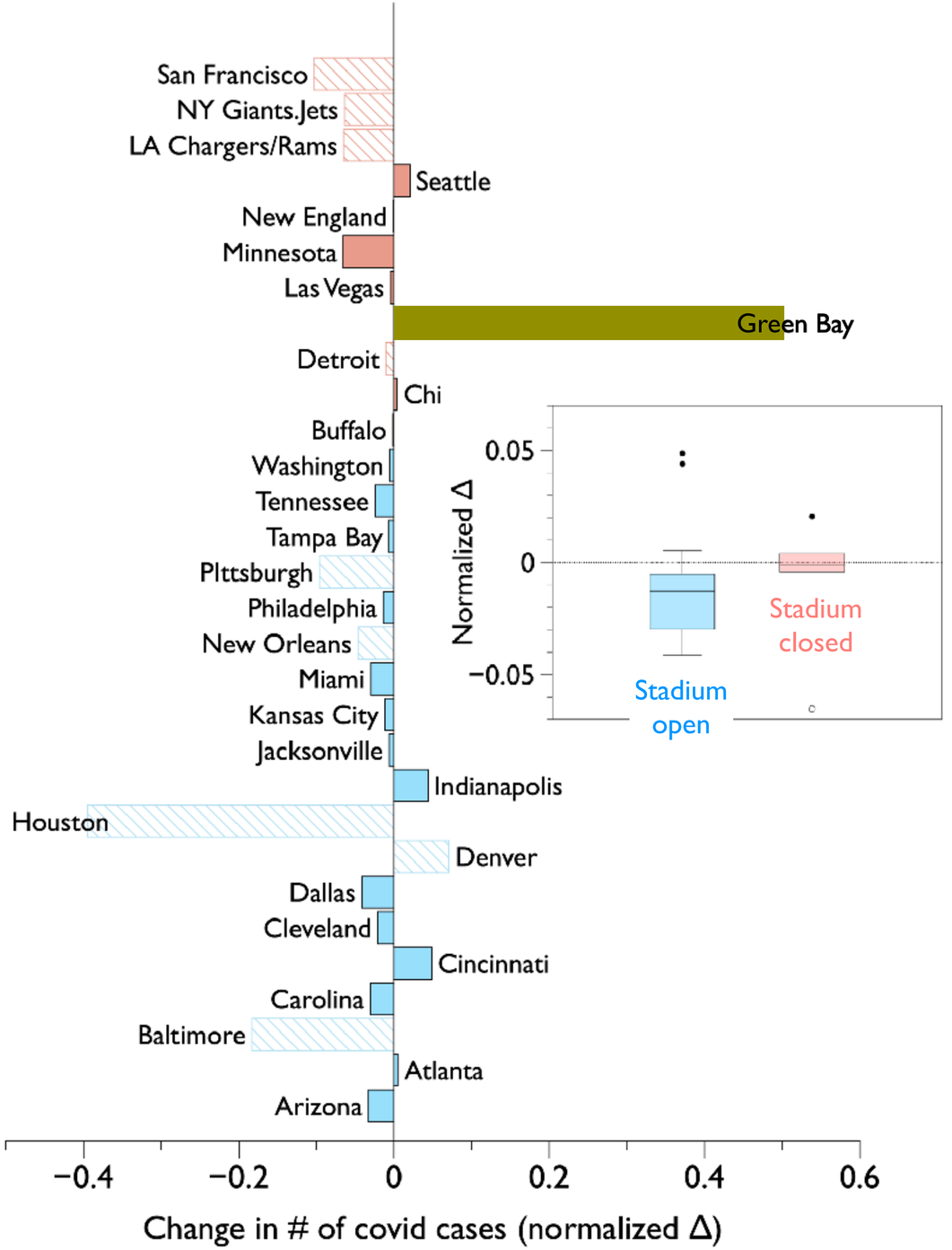
COVID-19 Outbreak Associated with a 10-Day Motorcycle Rally in a Neighboring State — Minnesota, August–September 2020

Weekly / November 27, 2020 / 69(47);1771-1776

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

What can go wrong?





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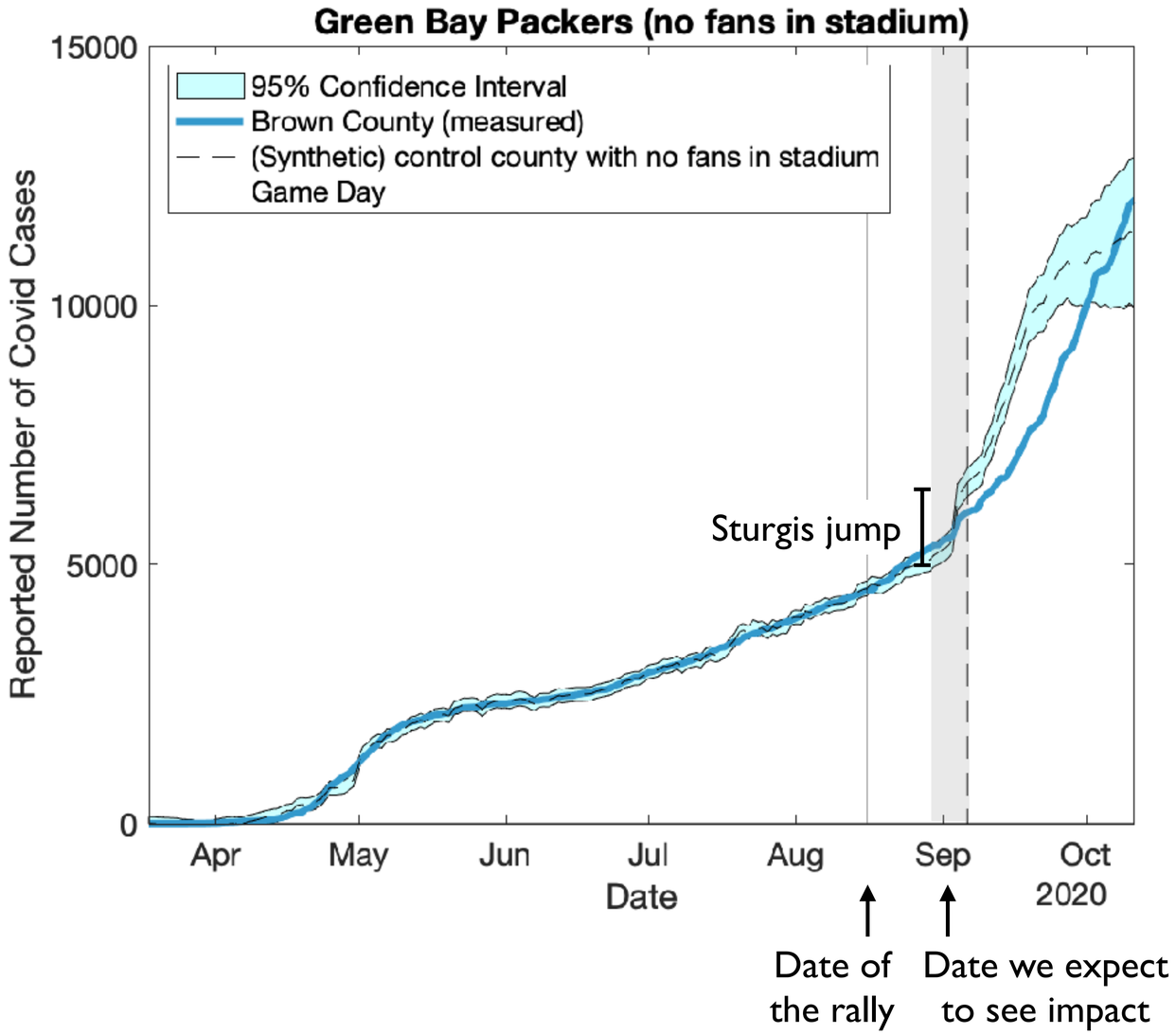

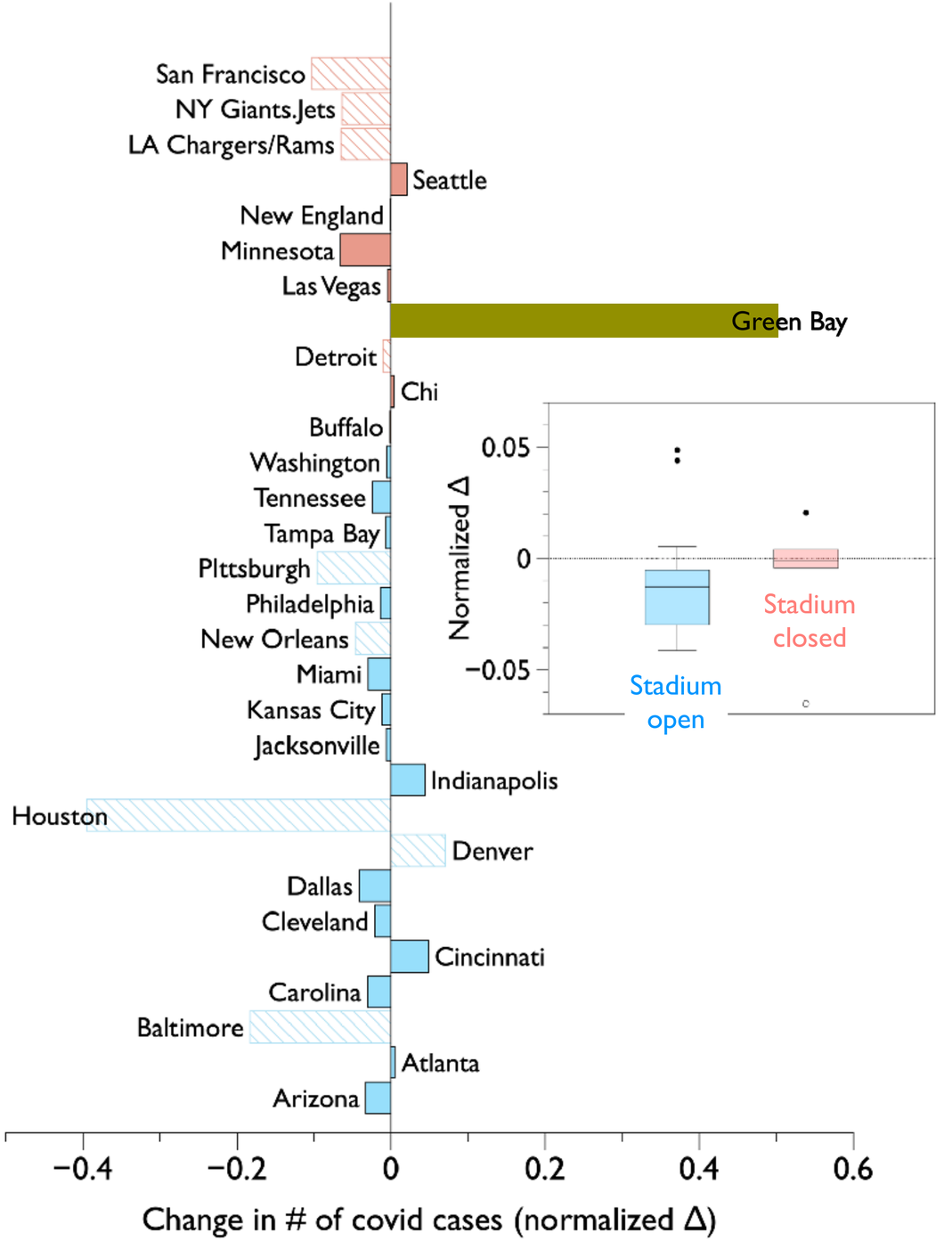

Controlled opening of stadiums
OK
Giant motorcycle rallies
OK

Dan Getty

William Li

Masayuki Yano

Charles Gao

Dennis Shen

Bernardo Bueno

FANDUEL

NFL